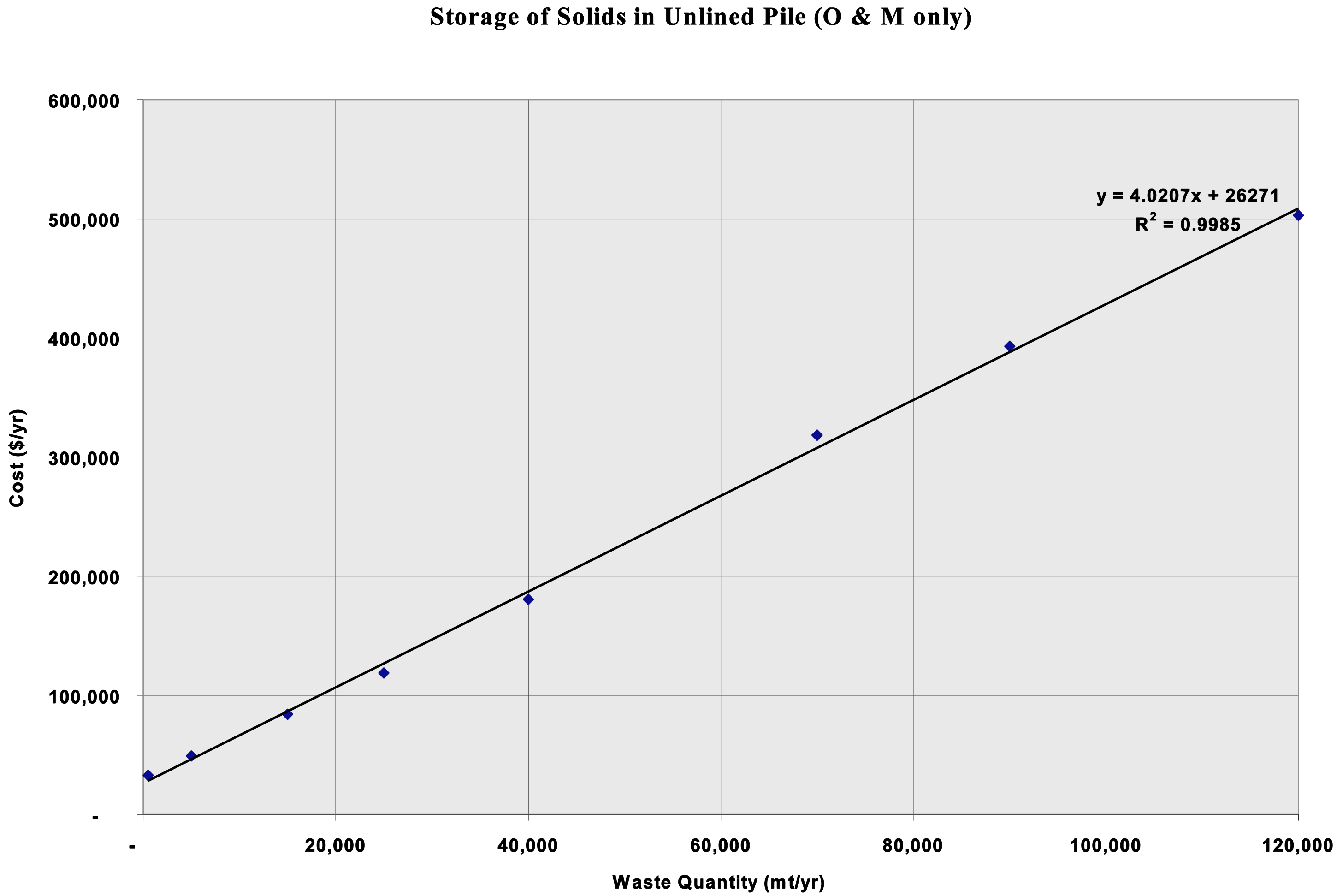
Exhibit D-28



Storage of Solids in Unlined Pile (O & M only)
600,000
500,000
400,000
300,000
200,000
100,000
-
Cost ($/yr)
y = 4.0207x + 26271
R2 = 0.9985
-
20,000
40,000
60,000
80,000
100,000
120,000
Waste Quantity (mt/yr)

Exhibit D-29

Storage of Liquids in Drums/Mini-Bulks

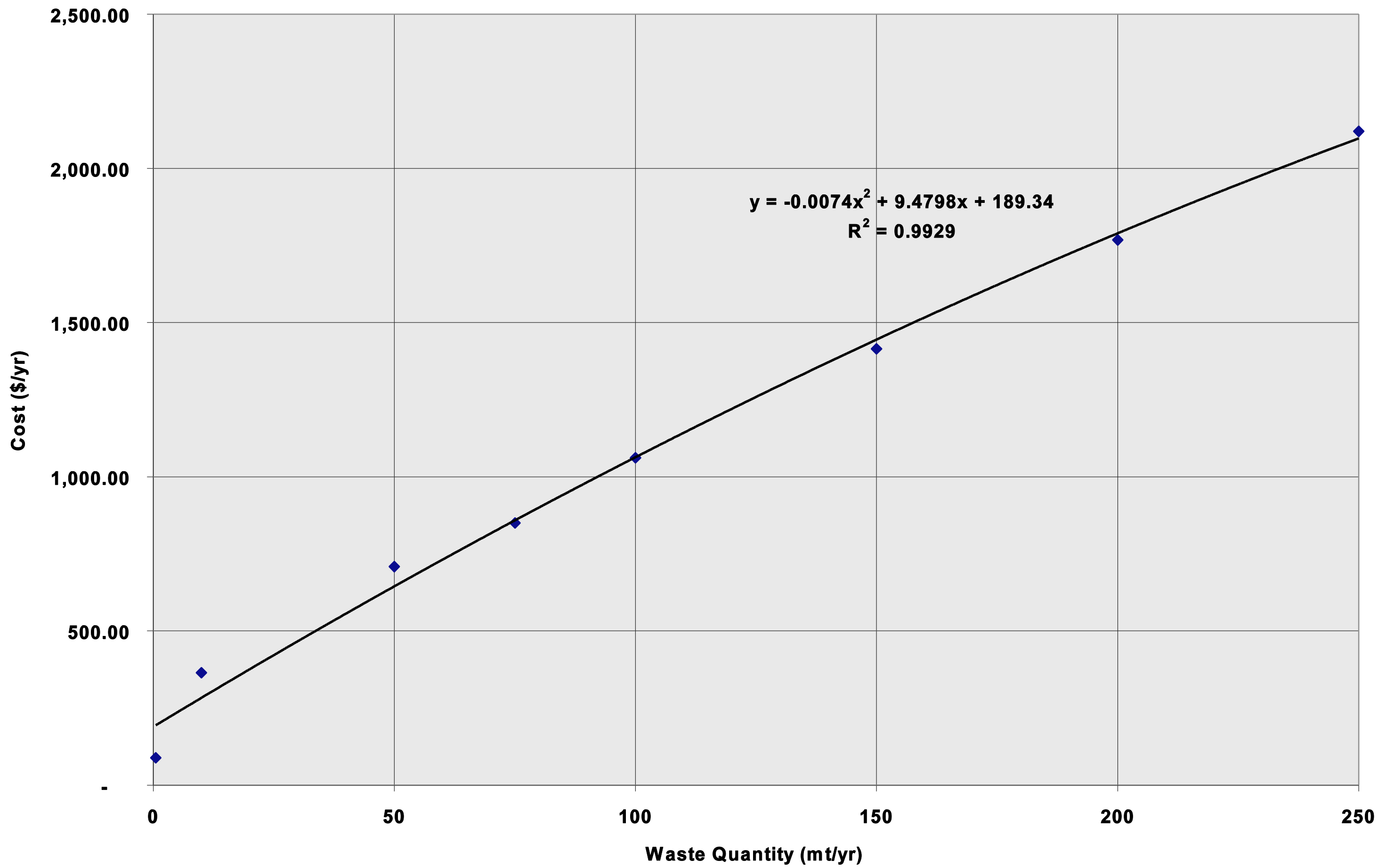
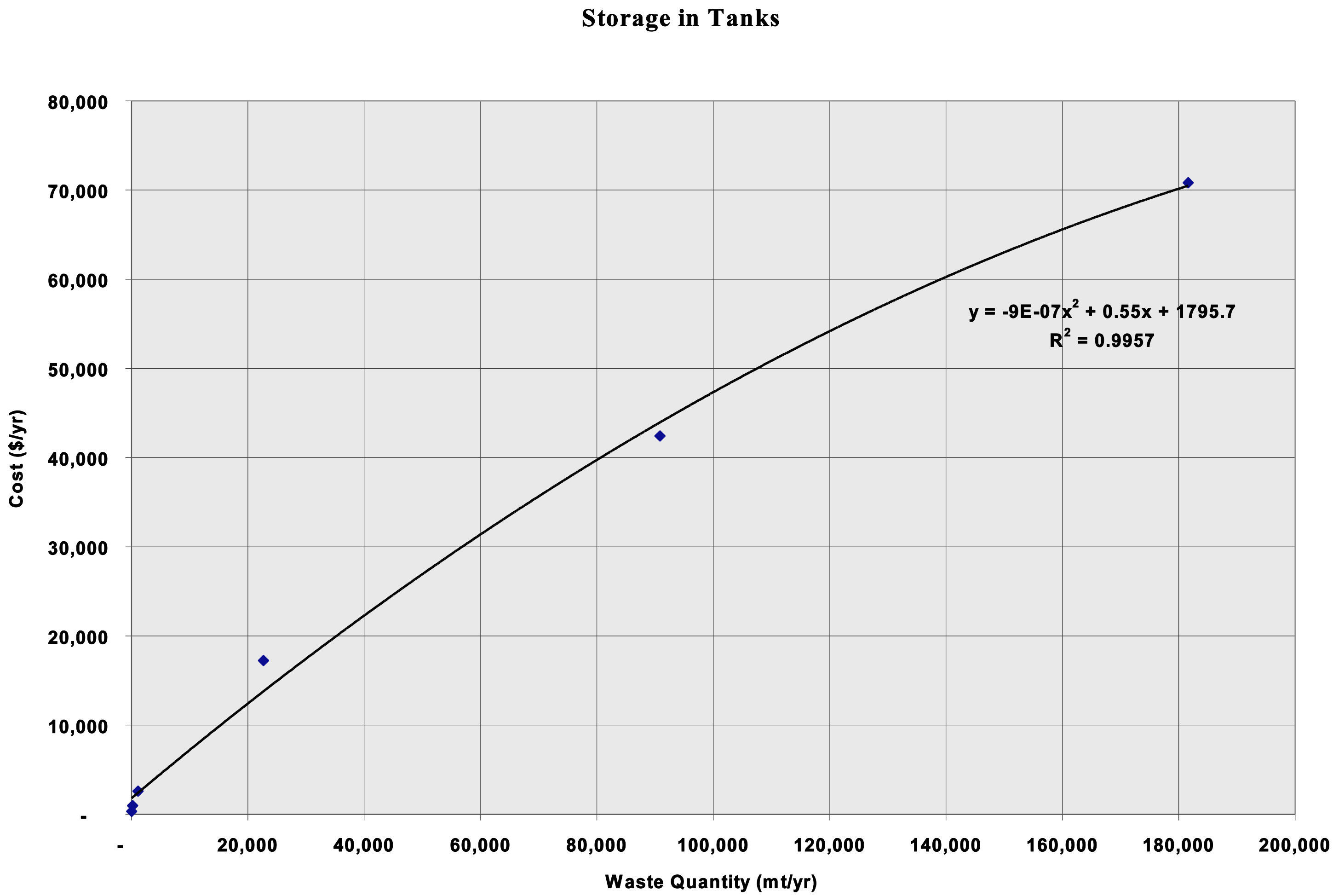


Exhibit D-30



Storage in Tanks
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
-
Cost ($/yr)
y = -9E-07x2 + 0.55x + 1795.7
R2 = 0.9957
-
20,000
40,000
60,000
80,000
100,000
120,000
140,000
160,000
180,000
200,000
Waste Quantity (mt/yr)

Exhibit D-31

Storage of Liquids in RCRA Tanks

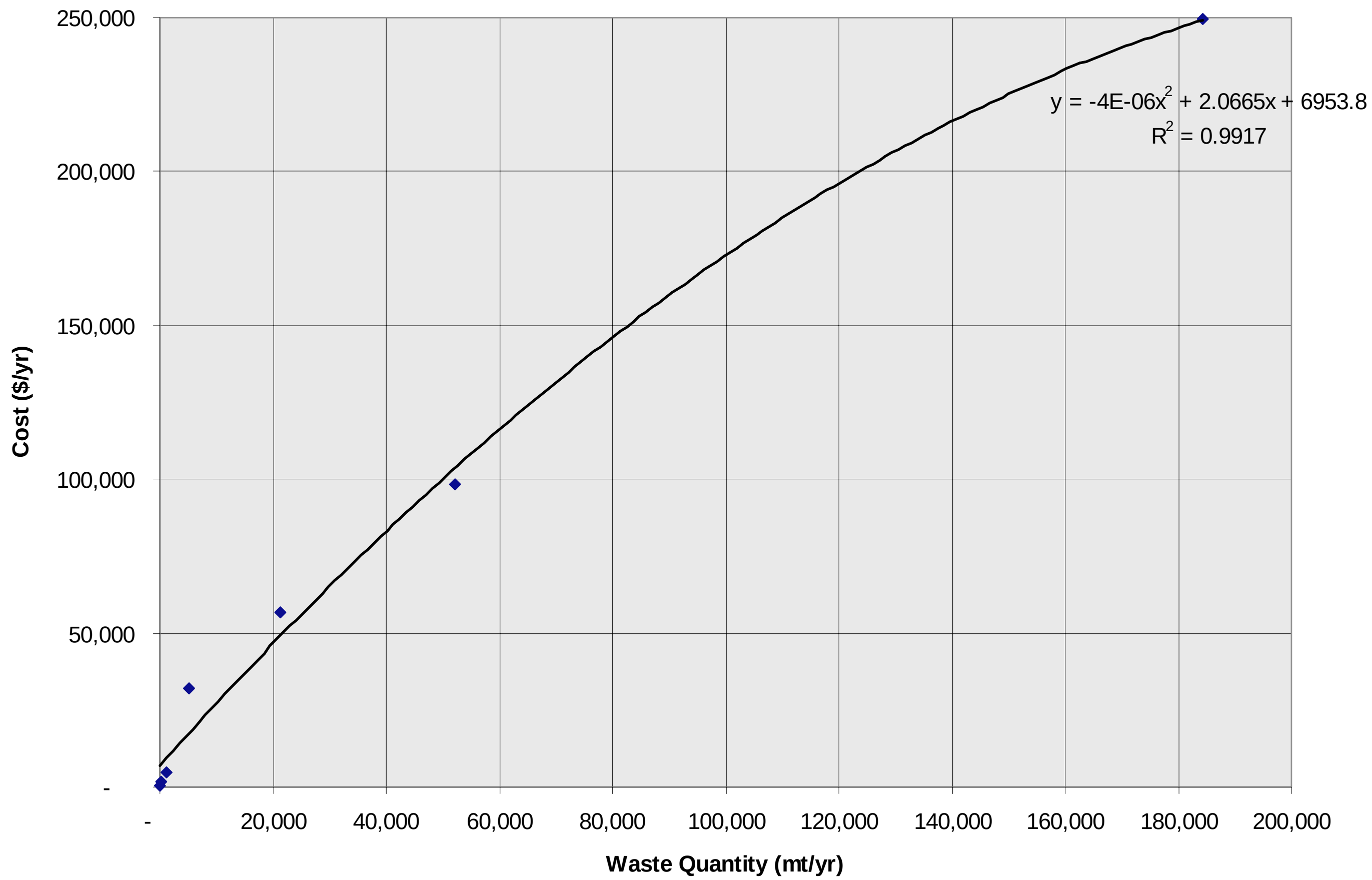
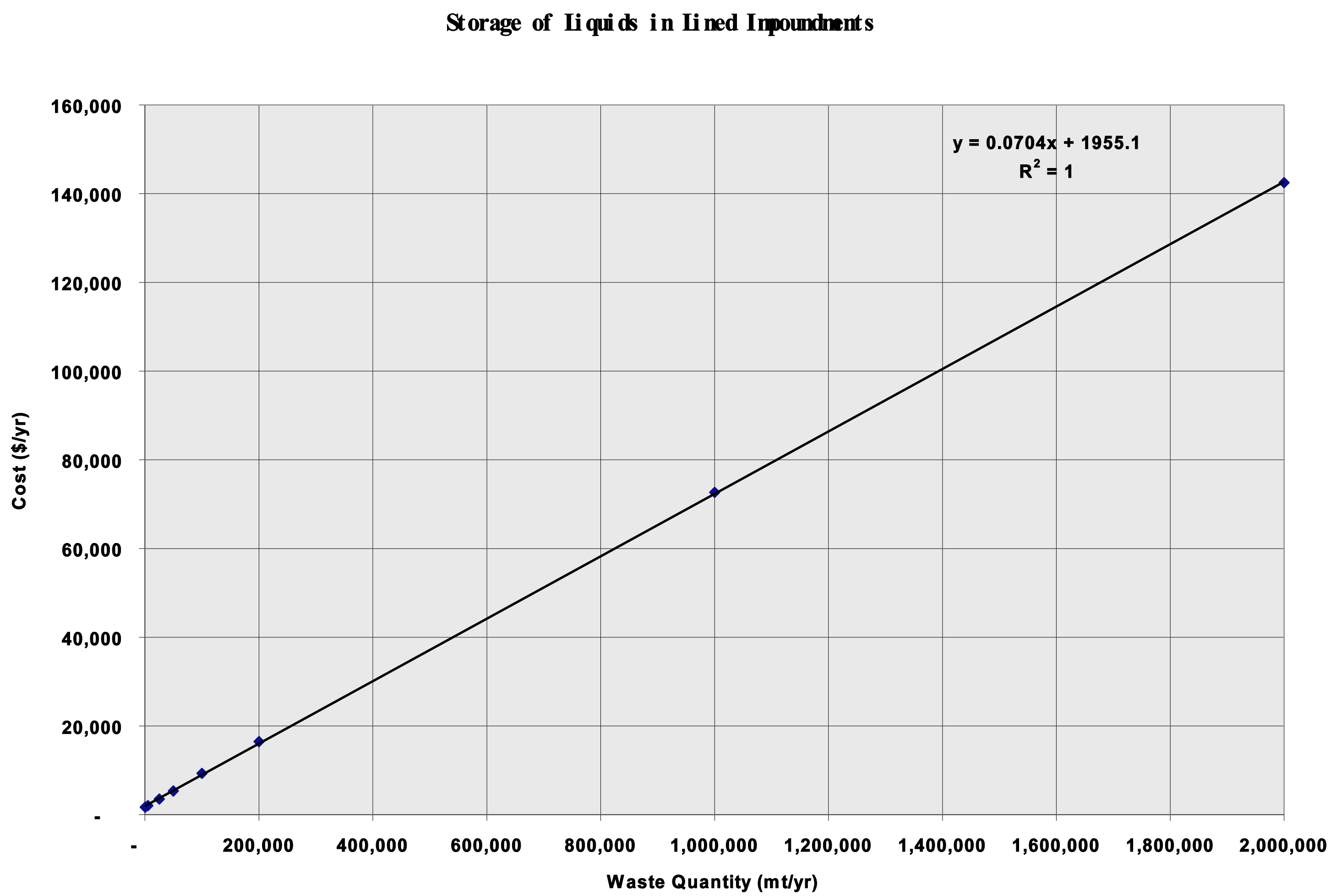
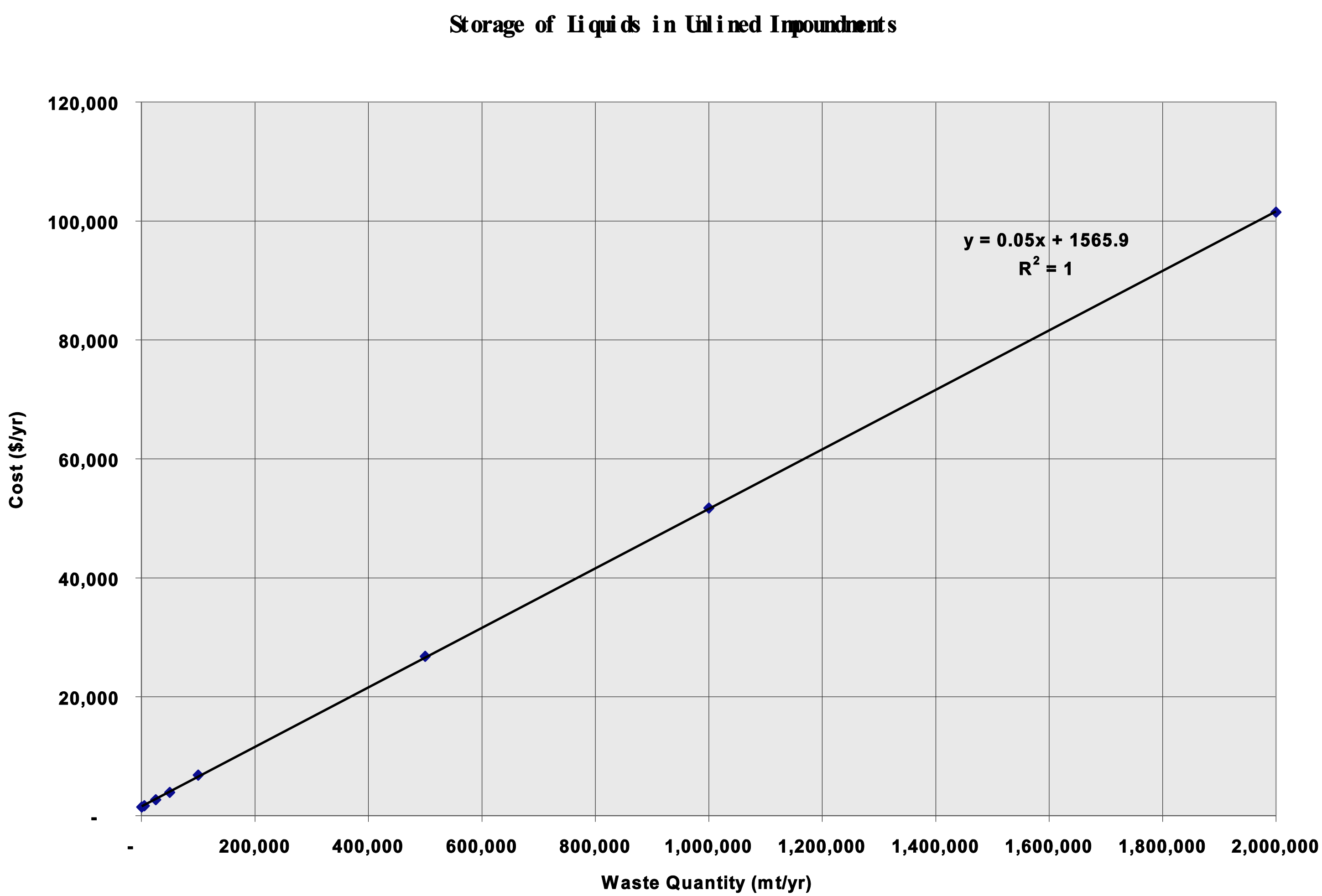


Exhibit D-32



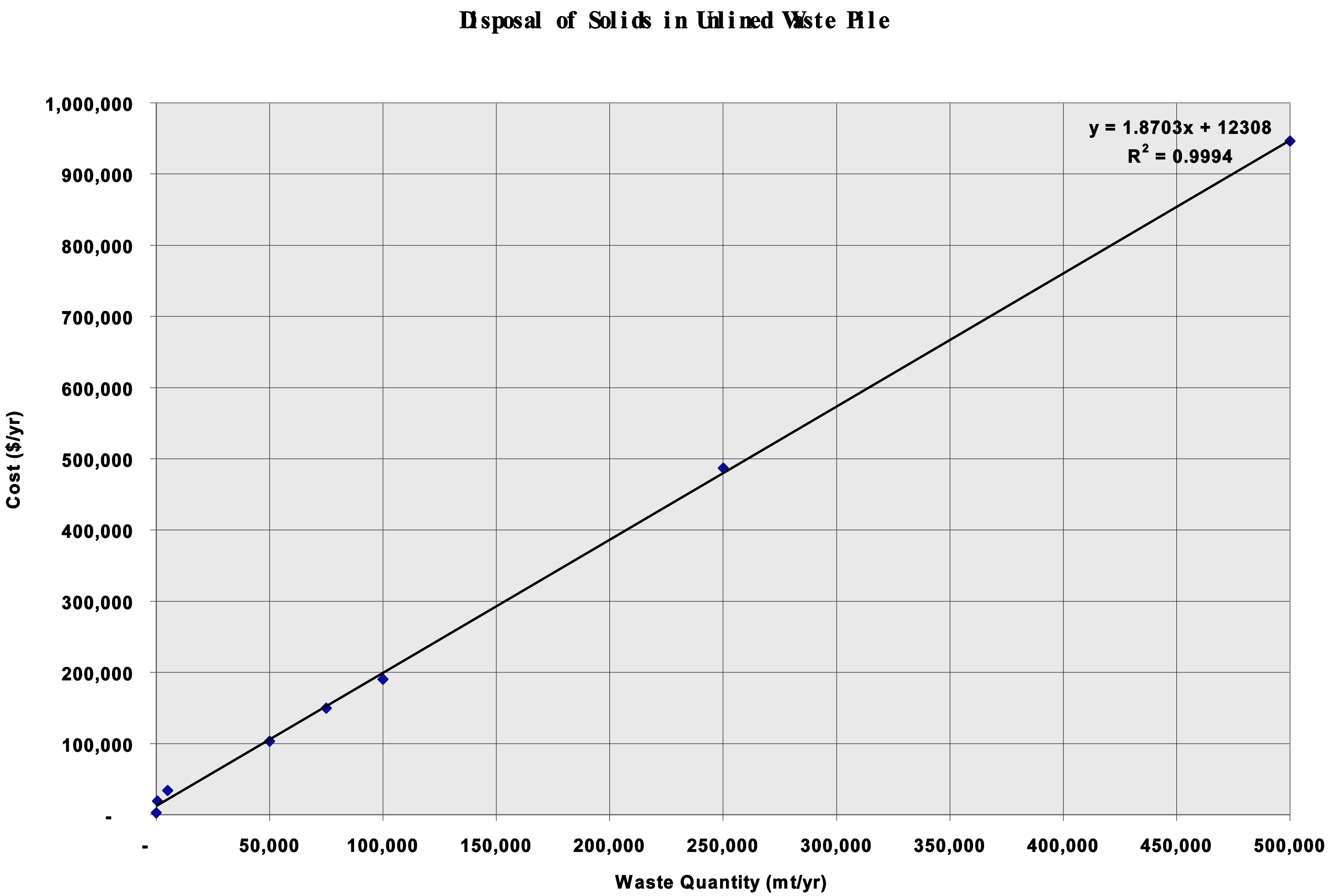
Storage of Liquids in Lined Impoundments
y = 0.0704x + 1955.1
R2 = 1
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
Cost ($/yr)
-
200,000
400,000
600,000
800,000
1,000,000
1,200,000
1,400,000
1,600,000
1,800,000
2,000,000
Waste Quantity (mt/yr)

Exhibit D-33



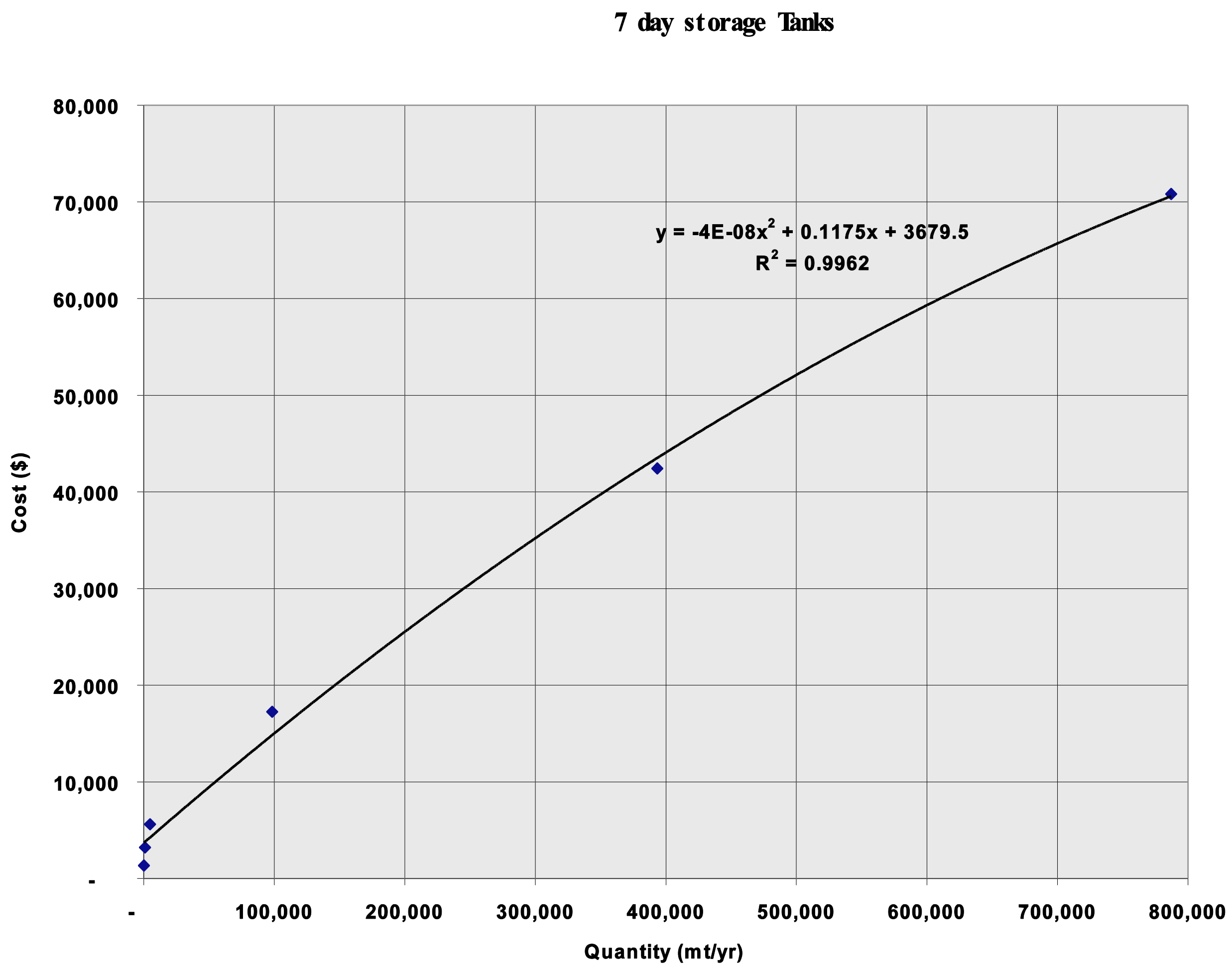
Storage of Liquids in Unlined Impoundments
120,000
100,000
80,000
60,000
40,000
20,000
-
Cost ($/yr)
-
200,000
400,000
600,000
800,000
1,000,000
1,200,000
1,400,000
1,600,000
1,800,000
2,000,000
Waste Quantity (mt/yr)
y = 0.05x + 1565.9
R^2 = 1

Exhibit D-34



Disposal of Solids in Unlined Waste Pile
y = 1.8703x + 12308
R2 = 0.9994
1,000,000
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
-
Cost ($/yr)
-
50,000
100,000
150,000
200,000
250,000
300,000
350,000
400,000
450,000
500,000
Waste Quantity (mt/yr)

Exhibit D-35



7 day storage Tanks
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
-
Cost ($)
y = -4E-08x2 + 0.1175x + 3679.5
R2 = 0.9962
-
100,000
200,000
300,000
400,000
500,000
600,000
700,000
800,000
Quantity (mt/yr)

D.7 Costs Associated with Groundwater Monitoring

Background and Requirements

Several options allow for storage of high volume material in land based units prior to reclamation, if several conditions are met. One of these conditions includes a groundwater monitoring requirement if unlined piles or surface impoundments are being used. The minimum requirements for establishing a ground water monitoring program include:

At least three downgradient and one upgradient ground water monitoring wells,
6 test borings (4 of which are converted into the wells), and
Sampling to indicate if hazardous contaminants are migrating out of the unit.

The specific costs associated with groundwater monitoring include the following.

Capital and Initial Costs

Installation of wells:	$5,600 / well (2 inch diameter, 50 feet deep)
Facility monitoring equipment:	$5,500 / facility
Administrative time	$15,360 / facility
- engineering study	
- soil borings	
- report preparation	
- sampling and analysis plan	
Establish Background Concentrations:	$600 / facility
	$6240 / well
Assess groundwater quality:	$1,860 / facility
Report Results:	$540 / facility
TOTAL FACILITY CAPITAL COST	$11,840(N+1) + $23,860

Operating and Annual Costs

Administrative Costs:	$930 / facility
- Evaluate groundwater elevation	
- Report results	
Sampling and Analysis:	$480 / facility
	$1,470 / well
TOTAL FACILITY OPERATING COST	$1,470(N+1) + $1,410

where N is the number of groundwater monitoring wells.

While the minimum number of wells is four (three down gradient and one up gradient), the Agency assumed that more downgradient wells may be necessary for large units. The procedure for determining the number of downgradient wells (N) is presented below. If N is calculated to be less than three, N is assumed to be three.

Number of Ground Water Monitoring Wells for Waste Piles

The waste is assumed to be stored in a conical pile. The number of downgradient wells (N) will be half the perimeter (P) of the waste management area divided by 150 ft. The waste management area is a circle surrounding the waste pile, with a radius of 30 feet plus the radius of the actual pile. Therefore, there will be one well every 150 feet around the 10 foot downgradient buffer of the pile, or

$$N = \frac{P}{2 \times 150}$$

where

$$P = 2\pi(r+30)$$

where r can be determined from the volume of the pile (V)

$$V = \frac{\pi \ r^2 h}{3}$$

If we assume h = r, this formula becomes:

$$V = \frac{\pi \ r^3}{3}$$

Solving for r,

$$r = \sqrt[3]{\frac{3V}{\pi}}$$

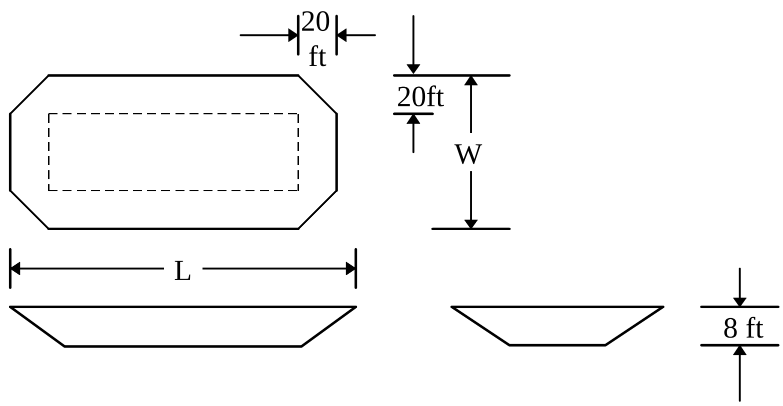
Therefore, the number of downgradient wells, by substitution is:

$$N = \frac{\pi \left(\sqrt[3]{\frac{3V}{\pi}} + 30 \right)}{150}$$

Where V is in ft^3.

Number of Groundwater Monitoring Wells for Surface Impoundment

Shape of surface impoundment as follows:



The number of wells (N) will be the half of the perimeter (P) of the waste management area, divided by 150 feet. That is, one well every 150 feet on the downgradient half of the perimeter of the 10 foot buffer zone surrounding the unit.

$$N = \frac{P}{2 \times 150}$$

where

$$P = 2(L + 20) + 2(W + 20)$$

The length and width of the unit can be determined from the volume. The volume of the unit in cubic feet can be calculated by breaking the unit into the center rectangular (swimming pool shaped) section, the four triangular (prism) shaped sides, and the four corner sections, or

$$V = V_r + V_s + V_c$$

Assuming a depth of 8 ft, and a side slope of 2.5 horizontally for every vertical foot (resulting in the outside 20 feet of the unit being part of the triangular sides), the volume of the center section (Vr) is

$$V_r = (L - 40) \times (W - 40) \times 8$$

The volume of the sides is calculated:

$$V_s = \left(2 \times \frac{1}{2} \times 20 \times 8 \times (W - 40)\right) + \left(2 \times \frac{1}{2} \times 20 \times 8 \times (L - 40)\right)$$

Finally, the volume of the corners is calculated by putting all four corners together to form a four sided pyramid, with diagonals of 40 ft. and sides of $20\sqrt{2}$. Therefore, V_c is:

$$V_c = \frac{20\sqrt{2} \times 20\sqrt{2} \times 8}{3}$$

Therefore,

$$V = (L-40) \times (W-40) \times 8 + \left(2 \times \frac{1}{2} \times 20 \times 8 \times (W-40)\right) + \left(2 \times \frac{1}{2} \times 20 \times 8 \times (L-40)\right) + \frac{20\sqrt{2} \times 20\sqrt{2} \times 8}{3}$$

By assuming L = 2W, this equation can be rewritten,

$$V = 16W^2 - 480W - 9387$$

Or, using the quadratic formula,

$$W = \frac{480 \pm \sqrt{(-480)^2 + 4(16)(9387 + V)}}{2(16)}$$

Therefore, substituting this back into the number of wells equation,

$$N = \frac{L + W + 40}{150} = \frac{3W + 40}{150} = \frac{\left[3 \times \left(\frac{480 \pm \sqrt{(-480)^2 + 4(16)(9387 + V)}}{2(16)}\right)\right] + 40}{150}$$